Educational practitioners as designers of seamless learning

Educational practitioners as designers of seamless learning: Lessons from a seamless learning scenarios design experience

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ABSTRACT
In theory, seamless learning design and research with its focus on bridging gaps in learning across contexts can help formulate answers to educational challenges. The recent mass lockdown due to the Covid-19 pandemic causing education to urgently switch from school-based to online teaching is just one of the many examples in support of design for continuity of learning. In over twenty years of its history, seamless learning has accumulated a substantial body of knowledge of what learning across contexts entails and how bridges across boundaries can be designed. However, seamless learning principles and guidelines to design for continuity of learning with the help of e.g., ubiquitous mobile technologies still need to find their way into educational practice.

The study focuses on the outcomes of a hands-on activity in designing seamless learning scenarios. This activity included getting acquainted with the basics of seamless learning and designing a seamless learning scenario. It was part of an event organized for educational practitioners interested in the topic of seamless learning. Analysis of the seamless learning scenarios collaboratively designed during this activity demonstrated that teachers build on inquiry-based learning and problem-based learning paradigms to design learning that combines in-school, out-of-school and online contexts. They were able to include location-based content in school and teacher-led scenarios, however, ideas on the use of mobile technology were still described rather vaguely. Crossing boundaries and removing seams between contexts, did not yet become apparent in these initial teachers' designs.

Author Keywords
Seamless learning, learning scenarios, educational practitioners, learning design, learning across contexts, teacher professional development

INTRODUCTION
In theory, seamless learning research with its focus on bridging gaps in learning across contexts, on how to achieve and maintain continuity of learning with the help of ubiquitous (mobile) technologies can help formulate answers to some of the new educational challenges. In 2020 we have witnessed a poignant example of such a challenge in the form of an urgent switch from school-based teaching to online teaching and communicating remotely with students against the backdrop of mass lockdowns due to the Covid-19 pandemic.

Education has responded to the first lockdowns by temporarily going online on an unprecedented scale (Surma & Kirschner, 2020; Williamson et al., 2020). As the pandemic waves persist and recurrent local or regional lockdowns have become a global trend, the challenge of re-conceptualizing relations between different forms of school-based, internet-based and out-of-school learning activities receives a major new impulse. Both the boundaries and the boundary crossings, including the crossings that are mediated by (mobile) technologies, need to be redefined (Bouw et al., 2019; Bronkhorst & Akkerman, 2016; Cremers et al., 2017; Kali et al., 2018; Kearney et al., 2012).

Seamless learning (SL) emerged from a trend in US higher education focused on connecting curriculum-based activities, in-class or on-campus learning with out-of-class, outdoors, off-campus learning experiences (Kuh, 1996, as cited in Wong, 2013; Wong, 2015). In its 'second life', from the first decade of the 21st century onwards, its focus has shifted to the use of ubiquitous personalized mobile technologies and to learning scenarios that integrate such technologies in order to connect learning across contexts in order to ensure its continuity (Wong, 2015). In the twenty years of its development afterwards, SL research has developed viable principles of boundary crossing with mobile technologies and accumulated a body of knowledge on SL scenarios in different educational domains as well as a plethora of exemplary implementations of such scenarios (e.g., Cremers et al., 2017; Tan et al., 2018; Wong, 2015). The concept of *seams* in relation to learning in different contexts remains, however, a broad concept that needs to be specified further. As Dilger and colleagues (Dilger et.al, 2019) point out in their problem analysis of SL, learning across contexts can lead to fragmentation of learning experiences instead

of bridging boundaries. Therefore, they argue for introducing the notion of seam-*aware* learning instead of seam-*less* learning.

In this sense, raising awareness of the potential of SL as well as of possible caveats of this approach to learning among a broader layer of educational practitioners is relevant. The tools and know-how originating from seamless learning research and design can enrich teachers' didactical and technological toolkit and thus better equip them to address new teaching challenges and learning across multiple, yet to be defined learning contexts, with a variety of yet to be defined tools (Goodyear, 2020; Lewin et al., 2018; Oh & Reeves, 2010).

The study presented here reports the outcomes of a hands-on activity in designing SL scenarios. The main question we aim to answer is whether the SL design approach we provided would enable educational practitioners to design viable seamless learning scenarios. The approach consisted of a short intensive introduction into the core ideas of learning without boundaries and seams across contexts, into the tools that can facilitate boundary crossing and the effort it may take, combined with a hands-on design workshop. As SL designers and researchers, we wanted to see which learning scenarios could be developed during such an activity. We examined which aspects of the SL concept and its design characteristics were immediately taken up as points of departure in design and were integrated in learning scenarios, and which SL aspects were not used. This allowed us to deduce which aspects require more attention and effort when educating practitioners for such design activities.

The paper presents the context of the study - the set-up of a one-day conference on Seamless Learning with a two-hour design workshop as a focal event. A brief summary of the event is provided to illustrate how the topic was introduced. Next, the paper describes the study we conducted on the outcomes of the design workshop, presents the results and offers an interpretation of these results. Finally, the paper goes back to the concept of seamless learning and attempts to build bridges between what the theoretical concept of SL entails and what educational practitioners eagerly embrace or neglect when designing for seamless learning. It offers insights that might be useful in formulating seamless learning design guidelines and professional development activities for educational practitioners.

THE CONTEXT

The study was conducted during a one-day conference on the topic of Seamless Learning. The conference targeted professionals in education (teachers) enrolled in a Master of Educational Science program at a European distance learning university and other professionals interested in the topic. Experts in the domain of mobile and seamless learning affiliated to this university and invited guests from other European universities with a solid research background in the domain and international experiences in implementing SL projects presented their research. Other speakers were developers of mobile applications used in SL design and representatives of learning-rich contexts (two museums and a zoo) where out-of-school learning activities take place on a regular basis or can be organized for different target groups.

The keynote speakers presented the state-of-the art on research and development of seamless learning. The speakers introduced SL as an approach to:

a) connect learning experiences and activities through technology-supported learning scenario's with wireless/handheld devices;
b) gain authentic learning experiences for and with learners in a variety of contexts (e.g., in school and out of school);
c) experience a continuity of learning across natural and designed locations, technologies and social systems, at different times and in different modes (adapted from Sharples et al., 2012, p. 24).

The keynote speakers also introduced the 10-dimensional framework of Mobile Seamless Learning (MSL) (Wong & Looi, 2011) in order to give the conference participants an idea of the multitude of ways learning can be either 'divided' or 'connected' when existing divisions and boundaries are lifted. The speakers presented both designed, planned and spontaneous, emergent SL activities in different physical settings and activities taking place online, along with mobile tools and apps used in educational practice in SL scenarios (based on e.g., Gülbahar et al., 2017; Suárez et al., 2018; Ternier et al., 2012). Following the presentations, the participants got an opportunity to explore several instantiations of SL scenarios and dedicated tools in an interactive poster walk session.

The conference program included a two-hour design workshop in which participants developed a blueprint of a SL scenario. Representatives of a local zoological park and two museums, one specializing in local history, genealogy and family history and the other specializing in local history and art, gave presentations about their respective contexts: what visitors could see, hear, experience and learn in each place. This allowed the conference participants to become acquainted with the vision and the mission of the zoo and the two museums, the 'content' available and the opportunities for learning in each setting. Furthermore, their presentations illustrated various dimensions of the presented MSL framework and both designed and emergent learning activities in such contexts that participants could include in their design.

Eleven teams of four to five participants then each designed a SL scenario. They were free to select a target group and find their own way of connecting learning in one of the presented contexts, at school, online or somewhere else. Throughout the session a design coach, a representative of the context and an expert on mobile applications were available for consultation and questions. Design teams had dedicated design kits at their disposal. Presentations of the scenario blueprints to the audience, and reflections by the participants, representatives of the three contexts and an expert panel concluded the

session. Conference participants gave their consent for the anonymous use of the artefacts and evaluation data as part of research on SL design methods.

DESIGN KIT

In their design activities, participants could use a didactical design kit that was presented in the theoretical part of the conference. The toolkit included an overview of the 10 dimensions of MSL (Wong & Looi, 2011), a typology matrix of SL scenarios (So et al, 2008), an exemplary overview of knowledge and skills that can be developed in an out of school activity (Generic learning outcomes, Hooper-Greenhill, 2007), a didactical design canvas for SL design (based on Rapp & Gommers, 2018) and an empty sheet for brainstorm notes.

PARTICIPANTS

Of all conference participants who took part in the design activity (*n*=49), 67% combined work in education with a part-time Master of Educational Science, but 33% were not connected to the educational program. Most participants worked in higher education (a university and applied science universities), further vocational education and secondary or primary education. Table 1 provides background characteristics in detail.

Participants	Gender		Educational domain where participants work, by type					total
	m	f	Higher	Vocational	Secondary	Primary	Other/unknown	
Students	7	26	12	7	6	8	-	33
Other	10	6	5	2	-	-	9	16
Total	17	32	17	9	6	8	9	49

Table 1. Background information of workshop participants (number, role, gender and professional domain).

DATA COLLECTION AND ANALYSIS

Our study reports on the analysis of eleven SL scenarios produced by the conference participants during the hands-on activity. The provided didactical design canvas was used by participants as a template for making posters that contained information on all design elements included in the canvas. However, the information varied in the degree of details presented and clarity and were not in all cases accompanied by the outcomes of the initial brainstorm. To be able to analyze produced scenarios as artefacts of SL design, all available information from the posters and brainstorm notes was first typed out. Descriptions of all design ideas per item of the design canvas (Rapp & Gommers, 2018) were used as data in this study.

The data analysis followed the guidelines for a thematic analysis (Ritchie et al., 2020) and included the following steps:

1. To ensure that the descriptions could be analysed with the same instruments, the first and the second author checked scenarios for consistency of descriptions, by reading all scenarios separately. They wrote down their opinions and exchanged notes to see whether there were striking differences in opinion regarding the use of these principles. The differences turned out to be minimal, they were easily resolved in discussion.
2. Based on the didactical canvas used in the workshop as a template and the resulting scenario descriptions a list of design elements was produced. This list was used to aggregate unique design ideas for each of the three contexts and over the contexts. Table 2 contains these design elements.
3. The first author aggregated all unique design ideas per design element for each of the contexts, the second author checked if the overview was correct and complete. Based on the subsequent discussion between the two authors, an overview of salient scenario elements per context was compiled (see table 2).
4. Thereafter, the first author applied the MSL framework by Wong and Looi (2011) and the matrix by So et al. (2008) to the aggregated scenarios, specifying themes that could be described as one of the MSL dimensions. The second author checked and confirmed the outcomes (see tables 3 and 4). Again, the authors discussed and resolved differences of opinion.
5. The outcomes of steps two and three provided insights in the extent of ‘seamlessness’ found in the scenarios produced.

RESULTS

An overview of the scenarios produced

In total 49 conference participants worked in eleven teams of four or five participants on SL scenarios for a context of their choice, resulting in five scenarios for the zoo context, four scenarios for the family history museum and two scenarios for the local history museum. Nine scenarios aimed at two main target groups: learners at the end of elementary school and beginning of secondary education (respectively 11-12 and 12-14 years). One museum field trip scenario is directed at older (15-22 years of age) learners in vocational education and one museum field trip scenario is directed at younger learners (9-10 years of age) exploring their hometown.

All scenarios follow a multi-phasic cyclic set-up, with an in-school starting point, an outdoors (field trip) inquiry activity or several activities and a finale in the form of a report of their experiences and outcomes, either oral (a presentation) or multimedia-based (e.g., a film). All scenarios include some form of group work, without being specific on the particular characteristics of such group activities. The starting point is teacher-led and includes some form of a trigger (Rusman, 2019) that gives meaning to the task that learners are expected to execute both in and out of class (please note that in-school and in-class is used interchangeably). All scenarios use the 'content' of the respective outdoors contexts to formulate learning objectives for the inquiry activities and provide meaningful triggers, such as learning questions and realistic tasks. The tools and technologies included in the scenarios are activity support tools: activity scripts, visual data collection tools, geographical positioning tools (e.g., google maps), information and activity sources (AR (augmented reality), VR (virtual reality) glasses, internet and communication tools (video conferencing). The descriptions of the functionalities of the tools and their intended use in SL scenarios, however concise, indicate that the workshop participants combined the information shared in the conference presentations on AR and VR, the scripting of activities within an app or 'hiding' information behind QR-codes (Quick Response) with 'mainstream' tools such as internet search engines and tools for presentation. Table 2 presents an aggregated overview of the scenarios per context.

Scenario		**Zoo**	**Museum 1 (Family history)**	**Museum 2 (Local history)**
		5 scenarios; created by 24 participants	4 scenarios (created by 19 participants)	2 scenarios (created by 8 participants)
Age target group		10-12 /12-14 year old	10 - 12 /12-14 /15-22 year old	9-10 /10-12 year old
School type		From K5-6 (upper elementary /middle school) levels till K8 level (low secondary) + further vocational + local elementary		
Learning objective	Knowledge	Animals in their natural habitat; awareness how life develops; sustainability goals /environmental issues	Personal and cultural identity; religions; citizenship; intercultural sensitivity; family & modern society; genealogy	History; local history; me and my hometown
	Skills	Doing systematic inquiry; critical thinking; collaboration; information literacy; presentation; problem solving	Doing genealogical research; 21st century skills; collaboration; presentation	Doing inquiry; information literacy, presentation
	Attitudes	Having fun; curiosity	Having fun; engagement; empathy; experience things taken for granted as special	Motivation
Pedagogical model		Inquiry-based learning; Collaborative learning; Problem-based learning; Game-based learning; Self-directed learning	Inquiry-based /discovery learning; Collaborative learning; Problem-based /Design-based learning	Inquiry-based learning; Experiential learning; Self-determination theory
Scenario in a nutshell		A planned learning activity in & out of school with a (laptop &) mobile device. Excursion @zoo, process & present results @school Vlog as a Trojan Horse: connecting all phases of the inquiry process	A planned learning activity in & out of school with a laptop and mobile device. @home, museum & school	A planned learning activity in & out of school with a mobile device. @museum, hometown & school
Phases of learning		*Phase 1:* A question generated @school. A kick-off to activate background knowledge *Phase 2: C*ollect visual data (video, photo, audio). Live & virtual experiences (e.g., feeding wild animals and birds) *Phase 3:* Collect & process data, formulate answers & present results. Offer solutions to a problem	*Phase 1:* Study own family history with DNA. Search & find information *Phase 2:* DNA research and migration of genes: collect information. *Phase 3*: Consolidate: connect phase 1 and phase 2. Individual or group reflection on a museum visit	*Phase 1:* Nominate a spot in town as a place of interest, teacher selects which to study *Phase 2:* Conduct inquiry in the local history museum and outdoors; collect data inside and outside *Phase* 3: Define unique selling points. Make a film. Organize an exhibition
Start inquiry (triggers)		*Questions:* How does an ideal zoo look like considering interests of animals, humans and environment? What would you like to learn with and from each other?	*Questions*: How far can you go in family history with DNA? Who am I genetically? Who am I culturally?	*Task*: Choose your favourite local spot (place of interest in your own town). Organize an exhibition about a museum /depot object

Actors	Teacher as a process coach A context representative (Zoo ambassador) as source of information	Teacher as a process coach Parents as a source of information and coaches in researching family history	Teacher as a coach
Tools and devices	Mobile device/powerbank; drone; GPS; QR codes; AR /VR; app for data collection; digital zoo map; internet, electronic learning environment, presentation tools; video conferencing; app given by the zoo	Mobile device; online storytelling; internet; AR /VR; Google maps; Google drive to store data; digital portfolio multimedia	Visual data: video, photo; internet library; Google maps, Google drive; collaboration tool; serious game; data over the town in QR codes

Table 2. Aggregated scenarios per type of context.

'Seamlessness' of produced scenarios

Table 3 presents the outcomes of the analysis of scenarios juxtaposed against the summarized descriptions from the MSL framework by Wong and Looi (2011) and Wong (2015).

Dimension	As described in the MSL framework	As represented in the SL scenarios produced at the workshop
MSL1 Formal (in-school) vs informal (out-of-school)	Formal learning is associated with learning **in school** and informal with learning that takes place **out of school.** More specific definitions include intentional teacher-driven learning as **formal learning in formal and informal contexts**. **Informal** learning is seen as unintentional and learner driven process that takes place out of school.	All scenarios combine **in school** and **out of school** learning activities. Activities are planned, **initiated and led by the teacher/school.** Scenarios can be typified as formal learning in school and out of school contexts. Scenarios that involve several out-of-school contexts (home, hometown, museum) may lead to spontaneous informal learning activities (e.g., drawing a family tree), this is however not explicitly included in the raw scenarios.
MSL2 Personalized and social learning	**Social learning** refers to group activities and collaboration (working on an artefact together, peer-feedback) with interaction in-situ or remotely, live and online, with or without devices. Personalized learning is typified as **individual learning** ('learning by themselves').	All scenarios integrate **collaborative activities** in the designs. There is little explicit division between individual and group work, partially because scenarios are not detailed. Collaboration is linked to doing inquiry together (collecting data), analysis and joint presentations. One scenario mentions peer-feedback.
MSL3/4 Learning across time and locations	Learning anytime and anywhere as **learning across time and location** is set against **one-off activities** taking place either within a relatively short period of time (e.g., three hours) or in or out of school (a field trip).	Learning takes place **'across locations'**. It starts at school, takes place at a different location (zoo, hometown, museum) and involves various actors (e.g., teachers, parents) and is to be completed at school or elsewhere. Time-wise, all activities are closer to **one-off activities** because they are part of a single task. There are no explicit references to duration or repeated or cyclic character of the activities.
MSL5 Ubiquitous knowledge access	**Contextualized and personalized information available to the learner just-in-time**, at the moment he/she is doing an inquiry is set against information that can be **retrieved by the learner from internet** either in advance or during an inquiry.	While descriptions are not explicit on this point, scenarios refer to AR (**contextualized access to information**, e.g., with QR codes) and VR (e.g., feeding lions), GPS and virtual maps as examples of contextualized just-in-time information. Most scenarios include **an information search activity as a regular part** of preparation for a field trip.
MSL6 Physical and virtual world	Refers to **activities** that take **place <u>both</u> in the physical and virtual world** set against scenarios when **learning** takes place **in either physical or digital context**.	In all scenarios learning activities are directly linked to **physical contexts out of school** and take place either at school or elsewhere. Learning activities in digital space are included in several scenarios, e.g., feeding lions with VR glasses.
MSL7 Combined use of devices	Refers to integrated use of **more than one handheld device and/or a laptop** to conduct learning activities. **Interaction between devices** supports bridging educational contexts.	There is little information on this aspect in the produced scenarios. While '1 gsm & 1 laptop' is mentioned in a scenario, there are no particulars on possible 'interactions' between devices.
MSL8 Switching between multiple learning tasks	Refers to the **integration of multiple individual and group tasks into a learning flow** mediated by a (mobile) device. In-situ activities (e.g., data collection with mobile devices) are connected with data-analysis and group interaction to enhance knowledge construction.	Integration of **multiple tasks that are constituent parts of the inquiry process:** information search to answer a question, data collection during a field trip, data analysis and presentation of results. Vlog is conceptualized as a linking pin between tasks (vlog as Trojan horse). Explicit reference to scripting activities within an app.
MSL9	Refers to the **integration of different knowledge types** (prior and new knowledge,	While scenarios are not sufficiently detailed and explicit about integration of prior knowledge, kick-off and other starting

Knowledge synthesis	different knowledge domains), in order to provide 'a rich interplay and intermingling of concrete levels of thinking with abstract levels of thinking' with the help of mobile devices.	activities can fulfil the function of connecting new and prior knowledge. Suggested **triggers for starting inquiries** support meaningful learning and knowledge extraction and processing from different sources.
MSL10 Multiple pedagogical models	Refers to the possibility of seamless **'switches' between multiple pedagogical models** (e.g., self-regulated learning, inquiry-based learning, collaborative learning). The core idea is ensuring a more diverse and rich learning experience.	Most scenarios name more than one pedagogical model or theory (e.g., SDT, self-regulated learning), but are not explicit about integration in design. **A combination of collaborative learning (groupwork) and inquiry-based learning** (doing and reporting an inquiry) is explicit in all scenarios.

Table 3. Scenarios produced at the workshop against the 10-dimensional MSL framework (Wong & Looi, 2011; Wong, 2015). Salient features in the original descriptions based on Wong and in the scenarios produced are marked bold by the authors.

Table 4 provides a close-up view of the 'seamlessness' of the scenarios produced according to the typology of learning in and out of school as planned or spontaneous, emergent process based on the typology matrix by So, et al (2008). The scenarios produced thus can be typified exclusively as Type I and II activities, planned learning in and out-of-class (or in and out-of-school).

		Intentionality of the learning process	
		Intended/Planned	**Unintended/Emergent**
Physical setting	**Out-of-class**	**Type II activities:** Planned learning out of class, e.g. a field trip to an art school which is part of the school curriculum	**Type III activities:** Emergent learning out of class, e.g., capturing pictures and video clips directed by self-interest
		Is part of all scenarios which follow an inquiry learning model: fieldtrips in a museum or zoo are linked to data collection to answer the posed question and as a motivating activity (having fun as one of the objectives).	*Few references to such activities in the scenarios. Such activities can take place in experience-rich contexts such as the zoo or a field trip in your own town.*
	In-class	**Type I activities:** Planned learning in class, e.g. searching for answers in classrooms	**Type IV activities**: Emergent learning in class e.g., teachable moments not planned by the teachers
		Is part of all scenarios of inquiry learning: the trigger/question is introduced and discussed in-class, information search prior to a field trip and data analysis and processing as well as reporting takes place in class – these are planned curriculum based activities.	*No references to such activities in the scenarios.*

Table 4. Produced scenarios in the matrix of learning spaces by So et al (2008).

CONCLUSIONS AND DISCUSSION

The question that we posed in this study concerned a concept that is not defined unequivocally. 'Seamless learning' has already become an established domain in technology enhanced learning research. The concept of SL has been sufficiently defined and applied in empirical research and theory (e.g., Durak & Çankaya, 2019; Jagušt et al., 2018; Milrad et al., 2013; Wong, 2012; Wong, 2015). However, 'how seamless' a concrete instantiation of an SL scenario has to be, needs to be defined in each concrete case because of the multidimensionality and openness to interpretations of the paradigm.

In this study, we used two basic typologies to analyse the seamless character of learning scenarios designs produced during a dedicated hands-on activity by educational practitioners interested in SL – the 10 dimensions MSL framework (Wong & Looi, 2011) and the typology of learning spaces by So et al (2008). These frameworks allowed evaluation of the extent of 'seamlessness' of designed scenarios:

- All scenarios position learning in two or more contexts: learning activities take place at school, outdoors (in the zoo, at home or in the hometown of the learners and/or in a local museum) as part of a single scenario of a whole learning experience.
- These experiences relate to the inquiry-based learning paradigm (e.g., Anastopoulou et al., 2012; Suárez et al., 2018; Tan et al., 2018). Designers suggest triggers - questions that need to be answered, problems in need of solution or a specific connector between activities (a vlog) as connecting elements or 'bridges' between contexts.
- All scenarios explicitly integrate 'content' and affordances of the chosen out-of-school context or multiple contexts (e.g., a place of interest in one's hometown, home and/or a local museum) through learning objectives, learning activities and the outcomes of these activities.
- Learning objectives refer to generic skills coined as 21st century skills (e.g., critical thinking), inquiry learning skills (posing a question, conducting information search, setting up an inquiry to collect data, analysing and reporting results), and 'citizenship goals': a broad cluster of orientations on a person in relation to broad societal issues.

- A school-based inquiry learning paradigm seems to be dominant in the perception of scenario designers when the task is to connect in-school and out-of-school contexts. However, designers conceptualize an inquiry as a *one-off* task with multiple connections between the learning activities *within* the task and hardly any explicit connections to curriculum goals, school subjects and domain related skills.
- Learning activities in the scenarios are initiated or triggered by the teacher who formulates the task or the question that learners have to answer. Shared agency seems to be limited to task execution (e.g., data collecting, analysis and presentation) and artefacts that might be the outcome of inquiry (traditional report presentation, a film, a blog, etc.).
- A core element of the concept of seamless learning - (mobile ubiquitous) technology as support for boundary crossings - is present in most scenarios. Storytelling, scripting of inquiry activities (data collection), AR and VR presence in the scenarios indicate that the concept has been understood. However, the absence of specific information makes it difficult to estimate how the designers envisage the integration of tools as 'connectors' between contexts and dimensions of learning. This vagueness about the functions of mobile technologies is in contrast with the clear way tool support for activities such as information search, presentation and communication are described.

To sum up, we may conclude that after the workshop participants got a broad notion of what SL entails. They were able to use these insights in designing learning scenarios with a reasonably good fit to the seamless learning paradigm. However, they focussed rather on designing learning activities that includes learning in formal and informal contexts, and less so on crossing boundaries and building explicit connections between formal and informal contexts, between instruction-based and inquiry learning, between planned and emergent learning and with shared agency of learning. These learning scenarios indicate that the question remains how important it is to 'remove seams' or 'cross borders' or that it might be sufficient, at least in first instance, to stimulate the learning process in particular contexts and raise awareness about seams (e.g., Dilger et al., 2019). The many opportunities provided by mobile and seamless learning to stimulate learner agency (Suárez et al., 2018) or to define a time/space relationship (e.g., Kearney et al., 2012) seem to remain new, undiscovered and unapplied for the participants of the design workshop. This, however, doesn't come as a surprise, as we would not expect participants to directly fully grasp the complexity involved in innovative design such as SL after a brief and generic introduction to the concept. Research confirms that even when teachers are interested in using tools in their educational practice, they tend to use communication and exchange tools instead of tools to stimulate knowledge creation and collaboration (Holmberg, 2017; Lewin et al., 2018) or tools specific for mobile and seamless learning. This suggests that the integration of tools in scenario designs needs to be a more prominent part of such 'learning by doing' events.

Of course, in a two-hour workshop participants can produce only limited scenarios and the participants might have needed more time to become accustomed to using tools like design canvasses. Moreover, team members needed to invest in getting to know each other and reach consensus. Therefore, this set up would need some follow-up activities, preferably anchored in or close to the educational practice of the participants.

This brings us to the last but not least point of discussion. The design workshop built on the theoretical introductions of the concept of SL, research findings and exemplary implementations. The scope was limited to a micro-level design perspective and so were the outcomes. This limited scope, however, contradicts the very idea of designing for continuity and for boundary crossing with mobile technologies. To overcome limitations of an intensive yet short hands-on training in SL design, it is imperative to take into account 'the big(ger) picture'. This training needs bridges to school learning and further education, societal trends, home and workplace situation, standpoints of different stakeholder groups (Rusman et al., 2018), etc. As such, it might become a constituent element of a teacher professional development 'curriculum' (Kali et al., 2018).

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